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17. ABSTRACT (MAX. 250 WORDS) The effects of a number of variables basic to the learning of foreign language vocabulary were reported. The language selected for learning was Russian.

Subjects in the first experiment were 409 students from an introductory psychology course. From an English-Russian dictionary, a preliminary list of common verbs was selected which represented an action which could be filmed using easily obtained objects or persons. A list of nouns was compiled which met the criterion of relatively easy film ability and which could serve, grammatically speaking, as subjects or objects of the words in the verb list. There were five film versions used in films for both the verb list and the noun list.

The five film versions were either title words only, still pictures, silent motion pictures, sound motion pictures, and sound motion pictures with student participation. Subjects in the second study were 538 psychology students who were divided into groups and were presented one of a group of films emphasizing: either random or serial presentation of words; sound or no sound; still pictures or motion pictures; and pictures only or pictures plus English words, in all possible combinations.

Results were that: pictures of an object or act were a learning aid; learning was not affected by whether the pictures were moving or still, pronunciation of the words by the narrator or learner inhibited the learning to write them; women appeared superior to men in learning foreign vocabulary; films were a convenient method for repetitive presentation of new words; and serial order of presentation resulted in greater learning than random presentation, but when the stimulus words were reproduced in a different order, random presentation resulted in less forgetting. A technical appendix is included.

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EXPLORATORY STUDIES IN THE USE OF PICTURES AND SOUND FOR TEACHING FOREIGN LANGUAGE VOCABULARY

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Instructional Film Research
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C. H. S. Murphy, Captain, USN
Commanding Officer and Director

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3ND-P&PO

FOREWORD

Problem:

The learning of foreign languages often is a difficult and time-consuming task. Motion pictures have been proposed as a means for improving military language instruction. In this research still and motion pictures with and without sound were used under several conditions to discover their value.

Results:

1. Pictures of an object or an act are an aid to learning to write foreign words.

2. The pictures need not be in motion.

3. Pronunciation of the words by the narrator or learner seems to inhibit learning to write foreign words.

4. Women appear to be superior to men in learning foreign vocabulary.

5. Films are a convenient method for repetitive presentation of new words.

Recommendation:

For teaching foreign vocabulary it is recommended that use be made of visual aids in the form of pictures. Since still pictures appear to be as effective as motion pictures, it is recommended that the expense of producing motion pictures be avoided by using some means of presenting still pictures, where the task is one of learning to write the words.

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EXPLORATORY STUDIES IN THE USE OF PICTURES AND SOUND FOR TEACHING FOREIGN LANGUAGE VOCABULARY

by

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The Instructional Film Research Program
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INTRODUCTION

This is a report of two studies[2] undertaken to investigate the effects of a number of variables which appear basic to the learning of foreign language vocabulary. These variables included the use of words only, still pictures and motion pictures with and without sound and with and without the English words, student participation in the form of pronouncing the words, and the use of varied and constant orders of presentation of the words to be learned.

The Russian language was selected for learning, and the experiment was restricted to the teaching of vocabulary rather than extended to the more complex task of sentence construction. Furthermore, performance was measured by ability to write the Russian words rather than to both write and speak them.

These studies were planned as being introductory and basic to the whole problem of teaching foreign languages. It is believed that the findings also have some relevance to the teaching of technical nomenclature.

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1. The report on Study 1 is based on a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, in the Faculty of Pure Science, Columbia University, June 1953.

2. The first study was conducted by Dr. Kale who conceived the problem and developed the film versions and experimental procedures which, with some modifications and refinement, were also used in the second study. The second study was conducted by Dr. Grosslight, Associate Professor of Psychology, The Pennsylvania State University.

The two studies will be discussed separately and will be followed by a summary of results and conclusions, with some suggestions for further research.

Study No. 1

THE PROBLEM

The following problems were investigated:

A. Is there a difference in their effectiveness for teaching English-Russian vocabulary among:

1. Titles (English-Russian words only, projected on a screen);

2. Still pictures (representing the word to be learned with English and Russian words beneath the picture);

3. Motion pictures;

4. Sound motion pictures (in which the words are pronounced by a narrator);

5. Sound motion picture with student participation (in which the subjects pronounce the Russian word after the narrator).

B. Is there any difference between the still and motion picture methods in their effectiveness in teaching nouns as compared to their effectiveness in teaching verbs?

PROCEDURES

A. Selection of test material

The decision to use words from the Russian language was based primarily upon three considerations: 1) Subjects having prior knowledge of the language to be taught or a cognate language were to be excluded from an analysis of the data. In order not to lose too many subjects for this reason, it was necessary to select a language which is rarely studied in school and is only rarely spoken in American homes. 2) It should be one which students might have some interest in learning. 3) Skilled linguists were available and interested in cooperating in the research.

From an English-Russian dictionary a preliminary list of common verbs was selected which represented an action which could be filmed using easily obtained objects or persons. These were then transliterated, i.e., spelled in the letters of the English alphabet, since the students who would participate in the experiment would not be available for a sufficient time to learn the Russian alphabet. There is no unanimity among Russian language experts as to the correct English spelling of transliterated Russian words. Therefore the transliterated words were submitted to three persons well-versed in Russian and, from those words on which the three could agree as to the correct transliteral spelling, thirty-two verbs were selected for filming (ten verbs and ten nouns were used in one list for a pre-test, twenty verbs were used for the experimental testing and two were practice words preceding the experimental sessions).

After the verbs were selected, a list of nouns was compiled which met the criterion of relatively easy filmability and which, in addition, could serve, grammatically speaking, as subjects or objects of the words in the verb list. This was done in order that the filmed words could later be used in experiments in which the task would be to form rudimentary sentences. This noun list was transliterated and thirty-two nouns were selected for filming. The Russian words (verbs and nouns) with their English equivalents may be found in Appendix 1.

B. The film versions

Five film versions, or five different methods of teaching, were used in films for both the verb list of twenty words and the noun list of twenty words.

Version 1. Titles words only. Only the English and Russian words were shown. There were no pictures or sound.

Version 2. Still pictures. The English and Russian words appeared below a still picture of the objects (if a noun) or a person or thing performing the action (if a verb). There was no sound.

Version 3. Silent motion pictures. The English and Russian words appeared below a picture of the object moving or being moved (if a noun) or the action occurring (if a verb).

Version 4. Sound motion picture. This version had the same visuals as Version 3. In addition the English and Russian words were pronounced by a narrator recorded on a sound track.

Version 5. Sound motion picture with participation. This version was the same as Version 4 with the addition that after the narrator pronounced the Russian word she said "Now you say it." The students then pronounced the word aloud.

In addition to the five versions of twenty nouns and twenty verbs an additional film, similar to the titles (words) only version, was made of a list of ten nouns and ten verbs which were different than the words appearing on the experimental lists. This film was used as a pre-test to obtain a measure of language learning ability to be used as the matching variable in an analysis of covariance.

Lastly, six additional films were made from one of the experimental film versions (nouns only). They were all alike except in the amount of time during which each word pair was shown on the screen. The time varied from 5 seconds to 11 seconds in six steps. These films were used in a pilot test with 104 subjects as a result of which it was decided to expose each word-pair for ten seconds and to repeat each film six times. (It will be seen below, however, that the results on the trials past the fourth were not used in the analysis of the data.)

C. The subjects

Subjects for the main experiment were 409 (202 women and 207 men) students recruited from introductory psychology course given at The Pennsylvania State University. The mean age of the women was 18.7 years, S.D. 1.95 and the mean age of the men was 19.84, S.D. 2.01.

All of the instructors, from whose classes the subjects came, agreed to add five points to their course grade if they participated in all five hours of the research. In addition, some instructors required a term paper of those who did not participate. Consequently, very few subjects were lost from week to week.

The students were able to indicate their preference for one of three nights in the weeks in which they would participate, it being understood that they would have to appear on the same night for successive weeks. In general, individuals were assigned to the evening of their choice although this could not always be done while keeping constant the numbers and the ratio of men to women in each group, both prior considerations.

Since only three or four of the experimental treatments were administered during any one evening, subjects could be assigned randomly

only to those treatments being given on the night they preferred. It was assumed, however, that the selection of preferred evenings would be more or less at random. Hence there was a quasi-random selection of subjects with respect to treatments.

D. The conduct of the experimental sessions

1. The pre-test

At the first meeting it was explained to the subjects that they were engaged in an experiment to test the effectiveness of the film as a medium for teaching Russian vocabulary. They were not told about the various experimental treatments (film versions) nor was the design of the experiment discussed with them.

The first session was devoted to a pre-test in which all the subjects were required to learn ten nouns and ten verbs different from those which they would be expected to learn during the main experiment.

The twenty word pairs (titles only) were shown. Then, the first English word of the list was shown followed by a period of ten seconds during which clear film ran through the projector, permitting enough light to be reflected back into the room to enable the subjects to write, if they knew it, the Russian equivalent of the English word. At the end of ten seconds both the English and Russian words appeared on the screen. Thus the subjects had another opportunity to learn the English-Russian word association. In the same manner, all twenty English words were shown, each followed by a period in which the subjects could write the Russian equivalent and after which the word pair appeared on the screen. The entire series of words was repeated six times[1] and at each repetition the subjects were asked to write the Russian word on a special answer pad described below. It should be noted that the words were presented in the same order for each repetition. Note also, that each repetition constituted both a testing and teaching opportunity. That is, subjects were tested by being required to write the Russian equivalent of each of the English words but after the opportunity for this had passed, the Russian word was shown, thus correcting or confirming the response. See Plate I which illustrates the film sequences for Versions 1, 2, and 3. In the pre-test the sequence was the same as version 1 (left strip).

A problem which had to be solved before this testing-teaching procedure could be used was that of insuring that students could not simply wait until the Russian word had appeared on the screen and copy it on their answer sheet or, more difficult to detect, remember the

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1. The repetition was actually achieved by using two prints and two projectors alternately. However, continuously projected film loops could have been used.

PLATE I

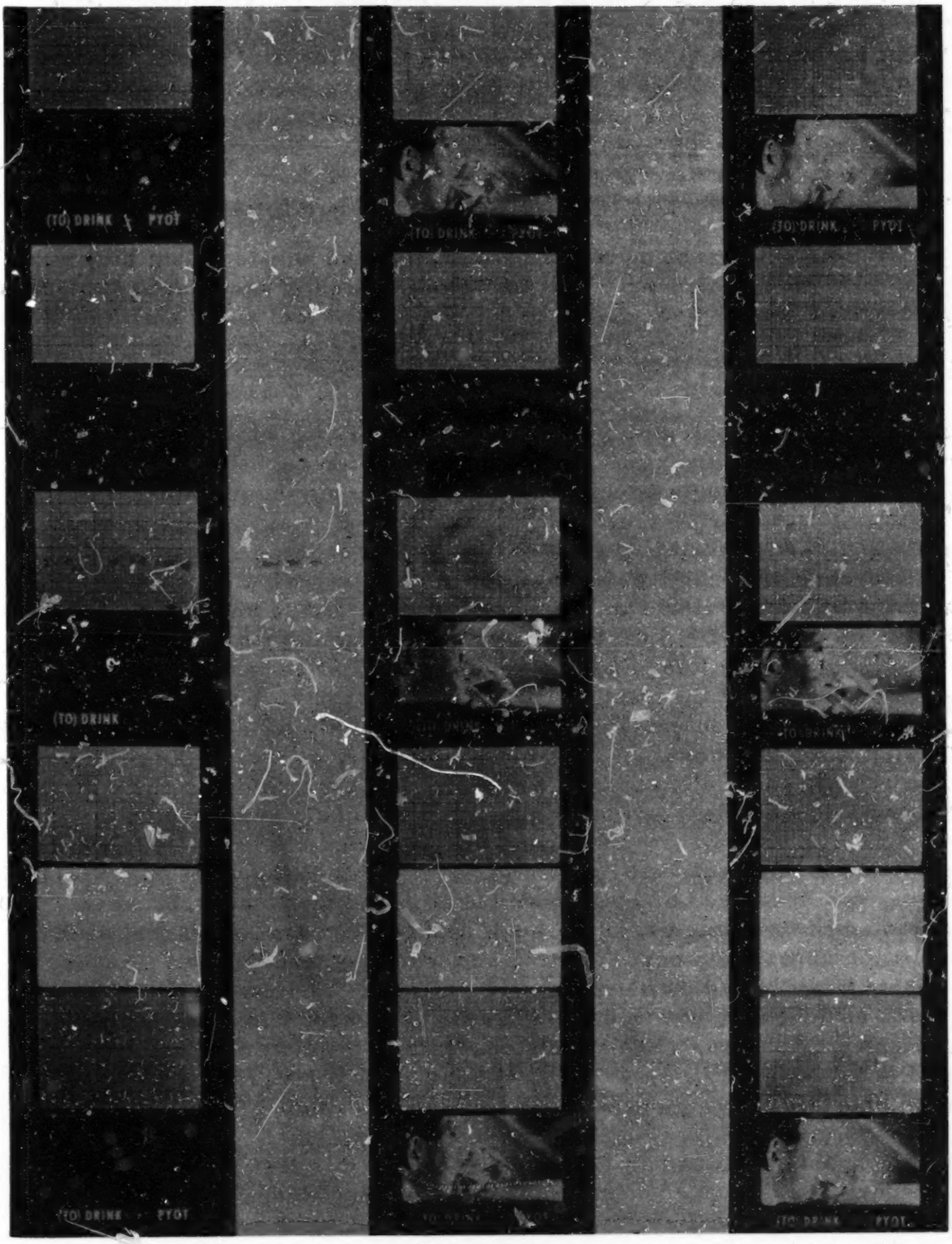

Plate I. Sample illustrations of the film sequences in experimental versions 1, 2 and 3. (The pictorial sequences in versions 4 and 5 are the same as in 3.)

Russian word which had just appeared on the screen just long enough to write it during the time they were supposed to be writing the Russian equivalent of the next word. In this way a subject could easily get a near perfect score although actually learning very little. This problem was solved in the following manner: Subjects were provided with desk calendar pad holders of the kind for which there is a page for each day in the year that is flipped over from right to left. Instead of calendar pads, the holders were fitted with a pad of blank pages, with each successive page a different color. The students were instructed to write the word and turn the page over before the Russian word appeared on the screen. A graph-like design appearing on the screen signalled that the Russian word was coming up and the page should be turned. The proctors knew at all times what color page the students should be writing on and it was therefore rather easy for them to correct anyone who got out of phase with the film. Plate II illustrates a subject using the test pad.

In this study, a word was counted as correct only if it were spelled without error. It will be seen that the criterion for an acceptable response was relaxed somewhat in the second study.

For purposes of the analysis, an individual's score on the pre-test (matching variable) was the average number of words correct on trials 3 and 4; his score on the criterion measure for the main experiment was the number of words correct on the fourth trial. The fourth trial was used as the criterion measure since inspection of the data seemed to indicate that by the fifth or sixth trials so many subjects had learned the list perfectly, regardless of treatment, that the effects of the treatments were minimized. Also it was felt that prior to the fourth trial the different treatments had not had the fullest opportunity to be effective. The third and fourth trials from the pre-test were averaged to yield the matching score since the average of two trials could be expected to be more reliable than the score on a single trial and, since the same version was used for all subjects, it was not necessary to be concerned about minimizing the relative effects of different treatments.

2. The main experiment

Each of the ten pre-test groups were assembled again one week after the pre-test. The testing procedure was essentially the same as that used for the pre-test. At this time, however, instead of each group receiving the same treatment, i.e., learning ten verbs and ten nouns by the "titles only" method, each group now received one of ten treatments, i.e., one of the five versions used in teaching a list of nouns or a list of verbs. These words were different than those learned in the pre-test.

PLATE II

Plate II. A close-up of one subject using his test booklet to write the Russian word "Voda."

STATISTICAL ANALYSIS AND RESULTS

The results of the analyses are summarized in Tables 1, 2 and 19. The analysis of covariance (Table 19) will be found in Appendix 2.

The analysis of covariance revealed a highly significant difference between the mean scores by sex on both the matching and criterion variables. In each case, women learned significantly more than men.

The difference between the adjusted mean scores with respect to the versions was significant. This will be considered in more detail below.

There was no significant difference with respect to the mean number of nouns versus the number of verbs learned.

No significant interactions were found.

Since there was a significant difference between the versions it was appropriate to determine the nature of these differences.

TABLE 1

MEANS AND STANDARD DEVIATIONS OF VERSIONS (Y)

Versions	1	2	3	4	5
Means	12.50	13.82	13.70	12.75	12.95
Adjusted Means	12.60	13.17	14.02	13.69	12.25
Standard Deviations	4.89	4.80	4.76	4.44	9.26
N	44	44	44	44	44

It will be seen in Table 2 that:

1. Version III (motion picture-no sound) was better than Version I (words only) and Version V (sound-motion picture with student participation).

2. Version IV (sound-motion pictures) was better than Version V (sound-motion picture with student participation).

3. No other significant differences were found between the methods of presentation.

TABLE 2

TABLE OF DIFFERENCES BETWEEN ADJUSTED MEASURES OF VERSIONS

	Versions'				
Version	1'	2	3	4	5
1		-0.57	-1.42*	-1.09	+0.35
2			-0.85	-0.52	+0.92
3				+0.33	+1.77**
4					+1.44*

' The sign for the difference was determined by subtracting the mean of the higher numbered version from that of the lower numbered version. The standard error of these differences was .65.

* Significant at the .05 level

** Significant at the .01 level

Study No. 2

This study is essentially an extension and an attempted clarification of the original project with a number of experimental modifications aimed at increased precision. The major emphases of this second investigation can be divided into three general areas:

A. Random vs. Serial Presentation

In Study No. 1, the English-Russian word pairs were always presented in serial (constant) order. Consequently, the possibility exists that the learning was not solely between the language pairs but was between Russian word and Russian word. That is, some subjects may simply have learned the list of Russian words in the order presented rather than having associated these words with their English equivalents. In order to ascertain the magnitude of the serial order effect, a comparison was made between groups learning under serial and random order presentation on the same English-Russian pairs. The investigation of this problem is designated as Experiment I in this study.

B. Picture and Sound Presentations

In the first study, all possible comparisons in regard to sound and picture variables were not investigated. Therefore, in order to further investigate the picture and sound variables and their interaction, the necessary controls and comparisons were instituted. The investigation of this problem is designated Experiment II.

C. Picture and Picture-Word Presentation

When several variables are operating simultaneously, it is often difficult to assess the relative contribution of any single variable. This problem exists when the English-Russian pairs are presented in conjunction with the picture representation. In this relationship, the question arises as to whether the stimulus for the Russian word is the English word or the picture. For example, when both the word "watch" and a picture of a watch are presented which stimulates the recall of the Russian word TSHASEE? An attempt was made to separate the stimulus component by presentation of the picture portion alone without the English word for both still and motion pictures without sound. This presentation was then compared to the presentation of the English word-Picture combination. The investigation of this problem is designated Experiment III.

In each of the three experiments the relative effectiveness of each variable on retention was studied.

EXPERIMENTAL DESIGN AND PROCEDURES

A. Experimental Design

The major experimental groups and comparisons are as follows:

Experiment I (Random vs. Constant Order of Presentation, Sound vs. No Sound) (All versions used titles only, no pictures)

Group 5: English and Russian Titles in random order with no sound

Group 2: English and Russian Titles in constant order with no sound

Group 9: English and Russian Titles in constant order with sound

Group 1: English and Russian Titles in random order with sound

	Order: Random	Order: Constant
No Sound	Group 5	Group 2
Sound	Group 1	Group 9

Experiment II (Sound vs. No Sound, No Pictures vs. Still Pictures vs Motion Pictures) (All versions in constant order)

Group 2: English and Russian Titles with no sound

Group 9: English and Russian Titles with sound

Group 3: Still picture with English and Russian Titles and no sound

Group 8: Still pictures with English and Russian Titles and sound

Group 6: Motion pictures with English and Russian Titles and no sound

Group 4: Motion pictures with English and Russian Titles and sound

	Picture		
	None	Still	Motion
No Sound	Group 2	Group 3	Group 6
Sound	Group 9	Group 8	Group 4

Experiment III (Pictures Only vs. Pictures Plus English Word)
(All versions in constant order with no sound)

Group 3: Still pictures with English and Russian titles and no sound

Group 7: Still pictures with only Russian word and no sound

Group 6: Motion pictures with English-Russian titles and no sound

Group 10: Motion pictures with only Russian word and no sound

	Stimulus	
	English-Russian Titles	Russian Word Only
Still	Group 3	Group 7
Motion	Group 6	Group 10

B. Subjects

The subjects for this experiment were 538 students from the Fall, 1953 classes of Psychology 2 at The Pennsylvania State University. Participation in this experiment was in partial fulfillment of the course requirement. This course requirement was instituted after the first study had been conducted.

C. Group Construction and Matching Procedures

1. Pretesting. One defect which may have existed in the first study was the unequal learning abilities of the various experimental groups. In the second study in order to equate all experimental groups and thereby increase experimental precision, all subjects were given a pre-test for matching purposes. The pre-test consisted of twenty (20) English-Russian noun pairs without sound or picture. (English-Russian verb pairs were used in the main experiment.) Each of the twenty pairs was randomly ordered in four presentations. The pre-testing was conducted in three separate 1 1/2 hour sessions over three nights. The response recording system described in connection with Study No. 1 was employed throughout this study.

2. Matching Procedure. The mean number of Russian words correct on the last two trials of the pre-test was used as the matching score. Separate matching procedures were followed for each sex. All the scores of each sex were ranked from highest score to lowest. Since ten groups were involved in the study, groups of 10 scores, i.e., highest 10 scores, second highest 10 scores, etc., were treated as equivalent ranks and distributed in a counterbalance order, one to each of the experimental groups. (See Table 3.)

TABLE 3

METHOD OF COUNTERBALANCE EQUATION OF GROUPS

	Groups									
	1	2	3	4	5	6	7	8	9	10
Highest 10 scores	1	2	3	4	5	6	7	8	9	10
2nd highest 10 scores	20	19	18	17	16	15	14	13	12	11
"										
"										
"										
etc.										

This procedure was carried out until all subjects of a particular sex were assigned. The same procedure was then followed for the other sex group. Any subjects with a mean last-two-trial-score of less than 6.0 were eliminated from the matching procedure. However, it was necessary to assign these subjects to the experimental groups for administrative reasons but their data are not included in any of the comparisons. The matching procedure resulted in 10 groups of 46 subjects each divided into 26 males and 20 females. Each group in turn was randomly assigned to one of the ten experimental treatments.

During the pre-test sessions, all subjects were informed of the requirements of matched group procedure in order to reduce absence in later sessions. In addition, each subject was requested to note any

night in the following week on which he could not attend. The matching procedure resulted in some assignment of subjects to nights of non-availability. As a result, some transfer of subjects between groups was necessitated. This transfer, however, was always done between subjects of equivalent or nearly equivalent pre-test scores.

D. Experimental Sessions

Approximately five days following the pre-test, the actual experimental sessions began. Three evenings were employed with either 3 or 4 groups per night involved. The procedure for these sessions was essentially the same as that followed in the first experiment except that each group was given only four instead of six repetitions.

E. Recall Sessions

One week following the experimental session, each group was shown their experimental film version in order to test recall. At this session only two showings were involved.

F. Scoring Procedure

In the first study perfect spelling of the Russian word was required. This was felt to be too stringent a criterion. Consequently, the criterion for a "correct" response employed in this study was that of no more than one spelling error in any Russian word. There were four categories of single errors allowed: (1) a single letter missing; (2) a single letter added; (3) transposition of adjacent letters; (4) one incorrect letter.

RESULTS

A. Pre-test or Matching

The matching procedure employed resulted in ten equivalent groups. (See Table 20 in Appendix.)

Analysis of variance for each of the three major experimental comparisons of the pre-test data indicated no significant differences between groups.

B. Experimental Sessions

1. Experiment I: Random vs. Serial Presentation

a. Pre-Test Equation: Although attendance in this session was exceptionally good, some loss of subjects did occur. In the case of matched groups by rank, this necessitated the loss of all subjects matched with the missing subject. Rather than lose all of these data, ranks 2 and 18 were dropped in all groups and the remaining scores were moved up so that 21 males and 18 females constituted each experimental group. Such a procedure is, in part, justified by the fact that score differences between adjacent ranks were very small. In fact, much score overlap between ranks on pre-test was present. No major significant differences existed between groups as the result of this procedure. (See Tables 21 and 22 in Appendix.)

b. Learning: The three major considerations of Experiment I were (a) comparison of random and serial order; (b) comparison of sound and no-sound; (c) interaction of sound and order variables (Groups 1, 2, 5, 9).

An examination of the data of this phase of the experiment leads to the general conclusions that (1) order of presentation makes a significant difference in learning; (2) the presence or absence of sound leads to no difference; (3) the presence or absence of sound interacts, to some extent, with order of presentation.

The comparisons between groups were made in two ways. First, a comparison of performance over the total four repetitions or trials (Tables 4 and 23) and secondly, on the last trial or repetition alone (Tables 5 and 24).

An examination of the analysis of variance (Table 23) indicates a number of significant sources of variance. A number of these significant sources of variance are relevant to the problem under consideration. An examination of the means of the respective groups and variable classifications will allow us to state the nature and direction of the effects.

A t test between Random Order groups (5 and 1) and Serial Order groups (2 and 9) results in a $t = 3.96$ which is significant beyond the .01 level. Consequently, serial order (constant order of presentation) leads to a significantly greater acquisition than does random order even

TABLE 4

MEAN SCORE FOR EACH GROUP AND COMBINED VARIABLE GROUPS BASED ON ALL TRIALS, N = 156, N = 312

Group	Condition	Mean
Group 5	Random - No Sound	7.8782
Group 1	Random - Sound	8.2756
Group 2	Serial - No Sound	9.2756
Group 9	Serial - Sound	8.6602
Groups 5 and 1	Random Order	8.0769
Groups 2 and 9	Serial Order	8.9697
Groups 1 and 9	Sound	8.4679
Groups 2 and 5	No Sound	8.5769

though the magnitude of this difference is only .8910. Since the analysis of variance showed a significant (at the .05 level) interaction effect between Order and Sound, it is desirable to make the appropriate comparisons. The mean difference between random order with sound and without sound is .3974 (t = 1.24) which is a non-significant difference. However, the mean difference between serial order with sound and no sound is .6154 (t = 1.92) which is just short of being significant at the .05 level. It is to be noted in this later comparison that the higher learning score with serial order occurs in the absence of sound; whereas in random order, the higher score is associated with sound. Consequently, the operation of sound as a variable seems to depend on order of presentation.

One finding consistently established in this study, which confirms the results of Study No. 1, is the superior learning by females over males. The mean score for females on all trials is 9.2083 in contrast to 7.9345 for males. A t-test of this difference (1.2738) results in a t = 5.61 which is significant beyond the .01 level.

A comparable analysis of the dat a based solely on the last (4th) trial of the learning phase tends to support the major findings stated above (Tables 5 and 24).

c. Recall and Relearning Trials: One week following the acquisition trials, each group was shown their experimental version twice. The first showing gives a measure of recall or forgetting whereas the second showing, when compared to the first showing, gives an indication of relearning. These, then, are the essential comparisons involved in this phase of the study.

TABLE 5

MEAN SCORE FOR EACH GROUP ON LAST LEARNING TRIAL, N = 39

Group	Condition	Mean
Group 5	Random - No Sound	12.54
Group 1	Random - Sound	13.67
Group 2	Serial - No Sound	15.10
Group 9	Serial - Sound	14.77

1. Re-equation: This third session resulted in additional loss of subjects so that some form of re-equation was necessary. This was accomplished by dropping all ranks in which one or more subjects were missing and thereby retaining only those ranks in which a subject completed all sessions. Consequently, the analysis is based on 17 males and 12 females.

2. Recall or Forgetting Analysis: The first trial of this last session is dependent upon retention and consequently a comparison of this trial with the last trial of the acquisition session gives us some idea of differences in retention related to each experimental condition.

It can be seen (Table 6) that differences in absolute number of words recalled did differ between groups. However, a direct comparison cannot be adequately made as the groups differed on learning. Consequently, the above differences in recall still reflect learning differences. It is desirable, therefore, to take the difference between the recall trial and the last learning trials. In this way, the difference score is adjusted, in part, for each subject's level of learning. In this analysis, then, the larger the difference score, the greater is the amount of forgetting or the lower is the amount of retention.

TABLE 6

MEAN NUMBER OF WORDS RECALLED ON FIRST TRIAL OF THIRD SESSION: EXPERIMENT I, N = 29, N = 58

Group	Condition	Mean
Group 5	Random - No Sound	1.8621
Group 1	Random - Sound	3.8621
Group 2	Serial - No Sound	3.2759
Group 9	Serial - Sound	3.3103
Groups 5 and 1	Random Order	2.8621
Groups 2 and 9	Serial Order	3.2931
Groups 5 and 2	No Sound	2.5690
Groups 1 and 9	Sound	3.5862

TABLE 7

MEAN DIFFERENCE SCORE: AMOUNT FORGOTTEN: EXPERIMENT I, N = 29, N = 58

Group	Condition	Mean Difference
Group 5	Random - No Sound	11.00
Group 1	Random - Sound	10.21
Group 2	Serial - No Sound	12.00
Group 9	Serial - Sound	11.96
Groups 5 and 1	Random Order	10.60
Groups 2 and 9	Serial Order	11.98
Groups 5 and 2	No Sound	11.50
Groups 1 and 9	Sound	11.08

Analysis of variance of the difference scores (forgetting) indicates that the difference between random and serial order is significant (Table 25 in Appendix).

The difference between random and serial order in forgetting of 1.38 is significant at the .05 level ($t = 2.08$ for 52 d.f.). This, then, indicates that serial order results in significantly greater forgetting

than does the random order. The difference in performance between sexes is again apparent in this analysis.

3. Relearning Analysis: The second trials of the last testing session give some indication of the amount of relearning achieved by one exposure to the experimental materials. However, this comparison must be made with regard to the performance on the recall trial (Trial 1). Therefore, the difference between trials 1 and 2 of this session would give some indication of differences in relearning as affected by the experimental variables.

TABLE 8

MEAN DIFFERENCE SCORE: RELEARNING
EXPERIMENT I: N = 29, N = 58

Group	Condition	Mean Difference
Group 5	Random - No Sound	9.76
Group 1	Random - Sound	10.93
Group 2	Serial - No Sound	11.52
Group 9	Serial - Sound	10.34
Groups 5 and 1	Random Order	10.34
Groups 2 and 9	Serial Order	10.93
Groups 5 and 2	No Sound	10.64
Groups 1 and 9	Sound	10.64

The analysis of variance indicates that there are no significant differences in relearning score for either order or sound variables (Table 26 in Appendix) although considerable relearning occurred.

It is interesting to note that the sound and order of presentation interaction is just short of an acceptable level of significance. The appearance of this interaction is suggested again in the relearning condition.

2. Experiment II: Picture and Sound Presentation

a. Pre-Test Equation: The re-equation procedure of Experiment I was employed for this experiment. No major significant differences existed between groups as the result of this procedure (Tables 27 and 28 in Appendix).

b. Learning or Acquisition: The three major considerations of Experiment II were (a) comparison of picture variable, i.e., no picture, still picture and motion picture; (b) additional comparison sound and no sound; (c) interaction of picture and sound variables (groups 2, 3, 6, 9, 8, 4). All films involved constant order presentation.

An examination of the data of this phase of the experiment leads to the general conclusions that (1) the presence of a picture associated with the English-Russian pair leads to superior learning over no picture, but there is no significant difference between still and motion picture; (2) the absence of sound (no-sound) leads to superior learning; (3) the interaction between picture and sound has no significant interaction effect; consequently, the sound interference operates regardless of the picture media.

The comparisons between groups were made in two ways. First, a comparison of performance over the total four repetitions or trials (Tables 9 and 29) and secondly, on the last trial or repetition alone (Tables 10 and 30).

An examination of the analysis of variance (Table 29 in Appendix) indicates a number of significant sources of variance. A number of these significant sources of variance are relevant to the problems under consideration. An examination of the means of the respective groups and variable classifications will allow us to state the nature and direction of the effects.

A comparison of titles (Groups 2 and 9) with Still Pictures (Groups 3 and 8) indicates that the mean difference of .62 is significant beyond the .01 level ($t = 2.82$). The mean difference of .69 for Titles and Motion Pictures (Groups 6 and 4) is likewise significant beyond the .01 level ($t = 3.14$). The difference (.07) between Still Pictures and Motion Pictures approaches no reasonable level of significance. Therefore, it may be concluded that a picture improves learning but it apparently makes no difference whether it is a still or motion picture with the words

and actions used.[1]

TABLE 9

MEAN SCORE FOR EACH GROUP AND COMBINED VARIABLE GROUPS BASED ON ALL TRIALS: EXPERIMENT II

Group	Conditions	N	Mean
Group 2	Titles - No Sound	156	9.28
Group 9	Titles - Sound	156	8.66
Group 3	Stills - No Sound	156	9.94
Group 8	Stills - Sound	156	9.24
Group 6	Motion - No Sound	156	10.01
Group 4	Motion - Sound	156	9.31
Groups 2 and 9	Titles - No Pictures	312	8.97
Groups 3 and 8	Still Pictures	312	9.59
Groups 6 and 4	Motion Pictures	312	9.66
Groups 4, 8 and 9	Sound	468	9.07
Groups 2, 3 and 6	No Sound	468	9.74
Groups 2, 9, 3, 8, 6, 4	Males	504	8.82
Groups 2, 9, 3, 8, 6, 4	Females	432	10.09

The mean difference between sound and no sound is significant beyond the .01 level (t = 3.72). It is interesting to note that in all group comparisons within the picture variable, those groups (Groups 2, 3, 6) associated with no sound are superior to those associated with sound (Groups 9, 8, 4). This comparison when made between sound and no sound groups within each of the three picture variables leads to t-tests significant at the .05 level or greater for all three comparisons. The exact reason for the no sound superiority is difficult to ascertain from this experiment. It is speculated to be an interference effect resulting from the difference between the way some words are spelled and the way they are pronounced.

1. It should be noted that only constant order of presentation was used in this part of the study.

Once again, the significant superiority of females on the type of task is demonstrated (t = 7.06).

A comparable analysis of the data based solely on the last (4th) trial of the acquisition phase tends to support the major findings of the more inclusive analysis (Tables 10 and 30).

TABLE 10

MEAN SCORE FOR EACH GROUP ON LAST ACQUISITION TRIAL
N = 39

Group	Condition	Mean
Group 2	Titles - No Sound	15.10
Group 9	Titles - Sound	14.78
Group 3	Stills - No Sound	15.69
Group 8	Stills - Sound	15.08
Group 6	Motion - No Sound	16.20
Group 4	Motion - Sound	14.79

c. Recall and Relearning Trials: The experimental procedure for this phase of the experiment is identical to the procedure employed in Experiment I (p. 16).

1. Re-equation: Because of the loss of subjects, re-equation was necessary. This was accomplished by dropping all ranks in which one or more subjects were missing. In this experiment, a greater loss of subjects occurred which required re-equation of the two groups involved in Experiment I as well. The final equated sample consisted of 14 males and 11 females.

2. Recall or Forgetting Analysis: The number of words recalled by each group can be observed in Table 11.

An examination of Table 11 would tend to indicate that the absolute recall was best for the motion picture groups on the picture variable and best for the no sound groups on the sound variable. However, such a direct comparison is difficult as these recall scores still reflect acquisition differences. It is desirable, therefore, to take the difference between the recall trial and the last acquisition trial. In this way, the

difference score is adjusted, in part, for each subject's level of acquisition. In this analysis, then, the larger the difference score, the greater is the amount of forgetting or lower is the amount of retention (Table 12).

TABLE 11

MEAN NUMBER OF WORDS RECALLED ON FIRST TRIAL OF THIRD SESSION: EXPERIMENT II

Group	Condition	N	Mean
Group 2	Titles - No Sound	25	2.88
Group 9	Titles - Sound	25	3.48
Group 3	Stills - No Sound	25	4.00
Group 8	Stills - Sound	25	3.32
Group 6	Motion - No Sound	25	3.80
Group 4	Motion - Sound	25	5.44
Groups 2 and 9	Titles (No Picture)	50	3.18
Groups 3 and 8	Still Pictures	50	3.66
Groups 6 and 4	Motion Pictures	50	4.62
Groups 4, 8, 9	Sound	75	3.06
Groups 2, 3, 6	No Sound	75	3.56

TABLE 12

MEAN DIFFERENCE SCORES: AMOUNT FORGOTTEN EXPERIMENT II

Group	Condition	N	Mean
Group 2	Titles - No Sound	25	13.04
Group 9	Titles - Sound	25	12.60
Group 3	Stills - No Sound	25	12.88
Group 8	Stills - Sound	25	11.68
Group 6	Motion - No Sound	25	13.44
Group 4	Motion - Sound	25	9.92
Groups 2 and 9	Titles Only	50	12.92
Groups 3 and 8	Still Pictures	50	12.28
Groups 6 and 4	Motion Pictures	50	11.68
Groups 4, 8, and 9	Sound	75	11.40
Groups 2, 3, and 6	No Sound	75	13.12

Analysis of variance of the difference scores indicates that the difference between picture treatments is no longer significant, but that sound treatment is significant (Table 31 in Appendix).

The difference in forgetting between all sound and all no sound presentations is 1.72 which is significant at the .01 level (t = 2.84). It is interesting to note that the previous relationship is now reversed, that is, the sound groups forget less than do the no sound groups. Consequently, it would appear in this phase of the study that sound reduces learning but facilitates retention as compared to no sound presentation.

3. Relearning Analysis: The second trial of the last testing session gives some indication of the amount of relearning effected by one exposure to the experimental materials. However, this comparison must be considered in comparison to the performance on the recall trial (Trial 1). Therefore, the difference between trials 1 and 2 of this session would give some indication of differences in relearning effected by the experimental variables.

TABLE 13

MEAN DIFFERENCE SCORE: RELEARNING
EXPERIMENT II

Group	Condition	N	Mean
Group 2	Titles - No Sound	25	12.12
Group 9	Titles - Sound	25	10.92
Group 3	Stills - No Sound	25	11.72
Group 8	Stills - Sound	25	10.96
Group 6	Motion - No Sound	25	11.68
Group 4	Motion - Sound	25	10.08
Groups 2 and 9	Titles Only	50	11.52
Groups 3 and 8	Still Pictures	50	11.34
Groups 6 and 4	Motion Pictures	50	10.88
Groups 4, 8 and 9	Sound	75	10.65
Groups 2, 3 and 6	No Sound	75	11.84

The analysis of variance indicates that the difference between sound and no sound groups is significant while picture differences are not significant (Table 32 in Appendix).

The difference between the sound and no sound groups of 1.19 is significant at the .05 level (t = 2.15). Apparently, then, on relearning the no sound groups do better than the sound groups. This tends to reconfirm the general finding that sound tends to interfere with or reduce learning.

3. Experiment III. Picture and Picture-Titles Presentation

a. Pre-Test Equation: The re-equation procedure employed in the previous two experiments was employed here. No major significant differences existed between groups as the results of this procedure (Tables 33 and 34).

b. Learning: The major problem of this experiment is concerned with the relative contribution of picture per se to learning. In all other experimental presentations of this study, the Russian word is learned in association with an English word and the possible addition of sound and/or picture. Consequently, the role of picture differences (still or motion) could be obscured by the presentation of the English word. In order to make this comparison, the no sound picture versions were shown with a masking shield in front of the projector which blotted out the English word associate. That is, just the picture was presented and the students had to recall the Russian word. These versions were then compared to comparable groups shown the same versions but with the English word associate included.

An examination of the data of this phase of the experiment tends to support the following conclusions: (1) picture presentation with English word associate included is superior to picture alone. However, learning to picture without the English word is high; (2) confirmation that picture difference, i.e., still or motion, is not a significant variable difference; (3) no significant interaction effect between type of picture (i.e., still or motion) and presentation of the English-Russian pair or the Russian associate alone is found.

As before, the comparison between groups were made in two ways, overall four learning trials (Tables 14 and 35) and last trial alone (Tables 15 and 36).

TABLE 14

MEAN SCORE FOR EACH GROUP AND COMBINED VARIABLE GROUPS BASED ON ALL TRIALS: EXPERIMENT III

Group	Condition	N	Mean
Group 3	English-Russian - stills	156	10.01
Group 7	Russian Only - stills	156	9.62
Group 6	English-Russian - motion	156	10.01
Group 10	Russian Only - motion	156	9.36
Groups 3 and 7	Still pictures	312	9.81
Groups 6 and 10	Motion pictures	312	9.68
Groups 3 and 6	English-Russian Pair	312	10.01
Groups 7 and 10	Russian Only	312	9.49
Groups 3, 7, 6 and 10	Males	336	9.11
Groups 3, 7, 6 and 10	Females	288	10.49

A comparison of the combined English-Russian groups (3 and 6) with Russian Only Groups(7 and 10) indicates that the mean difference of .52 is significant between the .02 and .01 levels of confidence (t = 2.46). The mean difference between combined Still Picture groups and combined Motion Picture groups of .12 approaches no reasonable level of significance. Therefore, it may be concluded that the presence of the English word makes a contribution to learning, although learning from the pictures without the English words is high (Groups 7 and 10). The no difference effect of still and motion picture stimulus is confirmed in this phase of the experiment. It is to be noted from the analysis that no significant interaction effect between the type of picture and English word presence or absence is found. Although in all cases, some picture with the English-Russian word combination is better. Once again, females are significantly better than males on this task with a mean difference of 1.38 (t = 6.45).

The analysis of the data based on the last trial of learning (Table 36) tends to support the findings of the more inclusive analysis. One exception needs to be noted as the analysis of variance on the fourth trial does not indicate a significant difference between the English-Russian and Russian Only groups.

TABLE 15

MEAN SCORE FOR EACH GROUP ON LAST ACQUISITION TRIAL
N = 39

Group	Condition	Mean
Group 3	English-Russian - stills	15.69
Group 7	Russian Only - stills	15.64
Group 6	English-Russian - motion	16.20
Group 10	Russian Only - motion	15.64

c. Recall and Relearning Trials: The experimental procedure for this phase of the experiment is identical to the procedure employed in Experiments I and II.

1. Re-equation: Because of the loss of subjects, re-equation was necessary. This was accomplished by dropping all ranks in which one or more subjects were missing. The final equated sample consisted of 12 males and 16 females in each group.

2. Recall of Forgetting Analysis: The number of words recalled by each group is given in Table 16.

An examination of Table 16 would tend to indicate no consistent differences among the major variables in terms of recall. However, as before, such a direct comparison is difficult as these recall scores still reflect acquisition differences. Therefore, a difference score between the recall trial and the last acquisition trial is more appropriate. In the analysis of difference scores, the larger the difference score, the greater is the amount of forgetting or lower is the amount of retention (Table 17).

The analysis of variance of the difference scores indicates that none of the major variables is significant (Table 37 in Appendix). Consequently, the amount of recall, when initial level of acquisition is adjusted for pictures with Russian words only is equivalent to pictures with English-Russian pairs, and Still and Motion Pictures are equivalent as well. The difference between males and females is significant beyond the .01 level.

TABLE 16

MEAN NUMBER OF WORDS RECALLED ON FIRST TRIAL OF THIRD SESSION: EXPERIMENT III

Group	Condition	N	Mean
Group 3	English-Russian - stills	28	3.25
Group 7	Russian Only - stills	28	3.32
Group 6	English-Russian - motion	28	3.46
Group 10	Russian Only - motion	28	2.71
Groups 3 and 7	Still Pictures	56	3.28
Groups 6 and 10	Motion Pictures	56	3.09
Groups 3 and 6	English-Russian Pair	56	3.36
Groups 7 and 10	Russian Only	56	3.02
Groups 3, 7, 6, 10	Males	48	3.35
Groups 3, 7, 6, 10	Females	64	3.06

TABLE 17

MEAN DIFFERENCE SCORE: AMOUNT FORGOTTEN EXPERIMENT III

Group	Condition	N	Mean
Group 3	English-Russian - stills	28	12.54
Group 7	Russian Only - stills	28	12.78
Group 6	English-Russian - motion	28	12.68
Group 10	Russian Only - motion	28	13.86
Groups 3 and 7	Still Pictures	56	12.66
Groups 6 and 10	Motion Pictures	56	13.27
Groups 3 and 6	English-Russian Pair	56	12.61
Groups 7 and 10	Russian Only	56	13.32
Groups 3, 7, 6, 10	Males	48	11.98
Groups 3, 7, 6, 10	Females	64	13.70

3. Relearning Analysis: As in the analysis of the other two studies a measure of relearning is obtained by a difference score between the second trial and first trial of the third experimental session (Tables 18 and 38).

TABLE 18

MEAN DIFFERENCE SCORE: RELEARNING
EXPERIMENT III

Group	Condition	N	Mean
Group 3	English-Russian - stills	28	11.82
Group 7	Russian Only - stills	28	12.07
Group 6	English-Russian - motion	28	10.89
Group 10	Russian Only - motion	28	9.61
Groups 3 and 7	Still Pictures	56	11.95
Groups 6 and 10	Motion Pictures	56	10.25
Groups 3 and 6	English-Russian Pairs	56	11.36
Groups 7 and 10	Russian Only	56	10.84
Groups 3, 7, 6, 10	Males	48	11.00
Groups 3, 7, 6, 10	Females	64	12.73

The analysis of variance indicates that relearning is superior for the English-Russian Groups over the Russian Only Groups. The mean difference of .52 gives a t = 2.26 which is significant between the .05 and .02 levels of confidence. Although a rough inspection of the means would tend to indicate superior relearning by Still Pictures, the analysis of variance does not support this as significant at any reasonable level of confidence.

It will be recalled that one of the major interests of this experiment is the relative contribution of various stimulus elements. In the first study some questions arose as to whether the major variables studied were affecting the results as much as would be expected because of the presentation of English words as well as pictures. This phase of the experiment does indicate that inclusion of the English word leads to superior acquisition and relearning. But this difference, although significant, is not of the magnitude which one might expect.

SUMMARY AND DISCUSSION OF RESULTS

The results of these experiments can be summarized most conveniently in terms of the principal comparisons. It must be emphasized that the results are applicable only when the criterion of performance is the ability to reproduce foreign words in writing. It is quite possible that the results, particularly with respect to the contribution of sound and student participation (in the form of speaking the words), might have been quite different had the criterion involved pronouncing the words.

1. Pictures plus titles versus titles only

In the first study motion pictures plus titles were significantly more effective than titles alone. There was no significant difference between still pictures plus titles and titles alone. However, in Experiment II of Study 2, both motion and still pictures with titles resulted in greater learning than did titles (words) only. The results indicate therefore that having a picture associated with a word aids in the learning of that word.

There were no significant differences between pictures plus titles and titles only in respect to forgetting and relearning.

2. Motion versus still pictures

A comparison of the relative effectiveness of motion and still pictures was made in Study No. 1 and Experiments 2 and 3 of Study No. 2. In no instance was there a significant difference in learning between groups taught by these two different methods. Nor was there any difference in forgetting or relearning. It should be noted, moreover, that in Experiment 3 no significant differences were found even when the English word was absent. In the other experiments subjects might have been associating the Russian word with the English word thus obscuring possible differences between pictures.

It was thought that motion pictures would be particularly advantageous in teaching active verbs but this was not supported in Study No. 1.

3. Sound versus silent

These comparisons tested the relative effectiveness of hearing the words pronounced as the stimulus pictures appeared on the screen as against the pictures without sound. In Study No. 1 and Experiment I of

Study 2, no significant differences were found between these two methods of presentation. However, in Experiment II of Study No. 2 no sound resulted in greater learning; that is, having the word pronounced seemed to interfere with learning as measured by written response in these studies.

There was no difference in the amount of forgetting between the groups in Experiment I of Study No. 2, but in Experiment II the group which heard the words pronounced forgot less than those who did not. In Experiment I there was also no difference between the groups with respect to relearning but, as in the original learning situation, no sound proved more effective than sound.

While the results of the experiment with respect to these variables are not clear cut, the preponderance of the evidence indicates that sound, at worst, interfered with learning and, at best, did not enhance it. It may be conjectured that since the pronunciation of the words frequently was different than the way one would expect it to be pronounced according to its spelling this discrepancy made learning to spell the words somewhat more difficult.

4. Participation versus no participation

Requiring the subjects to pronounce the Russian words after the narrator was found to inhibit learning. This effect was probably the result of accentuating the discrepancy between pronunciation and spelling.

This finding is not necessarily in conflict with the accepted idea that participation usually aids learning because in this study the kind of participation studied had to do with the pronunciation of the words, and the subjects were not tested for this. Participation relevant to the criterion, e.g., writing the Russian words, was not a variable in this study. However, all subjects "participated" in this sense.

5. Random versus serial(constant) order of presentation

The groups learning words which were always presented in serial order learned more than those groups learning words presented in random order. This suggests that the serial order group was learning, in part at least, by association with previous words in the list rather than by association with the stimulus words and pictures. The serial order group, when tested for the same words in a different order was found to have forgotten more than the random order group, although the number of words recalled was greater. Hence, in the practical learning situation randomizing the order of presentation might result in greater recall over

a longer period of time. Against this must be balanced, however, the convenience and smaller cost of presenting the stimuli serially.

6. Male versus females

While not one of the principal variables studied, women were found consistently to learn more than men, forget less, and relearn more. The differences were not always significant, but there were no reversals of this trend.

CONCLUSIONS

In teaching foreign vocabulary, when the criterion of learning is the ability to write the foreign words, it may be concluded that:

1. Pictures of an object or act are an aid to learning.

2. Whether the pictures are still or show objects or persons in motion does not seem to have an effect upon learning. This appears to be true whether the words to be learned are nouns, or verbs in which motion is intrinsic.

3. The pronunciation of the words by a narrator seems to inhibit learning as measured in these studies.

4. The pronunciation of the words by the learner seems to inhibit learning as measured in these studies.

5. Women appear to be superior to men in learning foreign vocabulary.

6. Films are a very convenient method for repetitive presentation of new words.

The serial order of presentation of stimulus words results in greater learning than random presentation if the task is to reproduce the words in the same order. However, foreign vocabulary is rarely, if ever, taught with the intent of preparing students to repeat a list of words. Therefore, since random presentation results in less forgetting than serial presentation when the words must be reproduced in a different order, random presentation may be more efficient.

RECOMMENDATIONS

1. In teaching foreign vocabulary it is recommended that use be made of visual aids in the form of pictures of the object or acts for which foreign words are to be learned.

2. Since still pictures appear to be as effective as motion pictures, it is recommended that the expense of producing motion pictures be avoided by using some means of presenting still pictures.

3. If it is only desired that the students learn to write the words being taught, it is recommended that they not hear or be required to repeat the sound of the words if the words do not sound the way they are spelled.

4. Additional research is needed to determine the effect of hearing and pronouncing the words when:

a. it is desired that the students learn to pronounce as well as write the words.

b. the words sound as they are spelled. This implies that the student first be trained in the rules of pronunciation for the language being studied.

5. Additional research is needed to determine the relative effectiveness of still and motion pictures when the task is one of building sentences rather than of learning single words.

APPENDIX 1

The Russian Words Used in the Experiments

and Their English Equivalents

(A) PAIRS OF ENGLISH-RUSSIAN WORDS SELECTED FOR THE CONTROL VERSION

1.	(To) SPEAK	- GOVORYT	11.	RAT	- CREESA
2.	COW	- COROVA	12.	(To) SEE	- VYDET
3.	(To) LOVE	- LYOOBOV	13.	COAL	- OOGOL
4.	CUP	- TSHASHKA	14.	SKY	- NYEBO
5.	(To) GATHER	- SOBYRAT	15.	BREAD	- CHLYEB
6.	(To) GROW	- RASTY	16.	(To) WEEP	- PLAKAT
7.	WIND	- VYETIER	17.	LIME	- YZVYEST
8.	FIELD	- POLEH	18.	HAM	- OCOROC
9.	CLOUD	- OBLACO	19.	(To) DRESS	- ODYEVAT
10.	(To) BOIL	- VARYT	20.	STAR	- ZVYEZDA

(B) PAIRS OF ENGLISH-RUSSIAN NOUNS SELECTED FOR EXPERIMENTAL VERSIONS

Practice Words

WATER	VODA
SHOE	BASHMAK

Test Words

1.	BOOK	- KNIGA	11.	NUMBER	- CHISLO
2.	BOY	- MALTCHYK	12.	DOOR	- DVER
3.	WATCH	- TSHASEE	13.	LETTER	- PYSMO
4.	WHEEL	- KOLESO	14.	CIGARETTE	- PAPYROSA
5.	APPLE	- YABLOCO	15.	DISH	- BLUDO
6.	BOX	- YASHTCHYK	16.	GIRL	- DEVOOSHKA
7.	LIGHT	- SVEYTLO	17.	COAT	- PALTO
8.	CANDLE	- SVECHA	18.	CARDS	- KARTHE
9.	CHILD	- REBYONOK	19.	GLASS	- STAKAN
10.	MAN	- TCHELOVYEK	20.	BELL	- KOLOKOL

(C) PAIRS OF ENGLISH-RUSSIAN VERBS SELECTED FOR EXPERIMENTAL VERSIONS

Practice Words

TO DRINK	PYOT
TO POLISH	POLIROOI

Test Words

1. (TO) BURN	- GORIT
2. (TO) WALK	- HODIT
3. (TO) SIT	- SIDIT
4. (TO) BREAK	- RASBIT
5. (TO) RING	- ZVONIT
6. (TO) PRAY	- MOLIS
7. (TO) OPEN	- ATKROY
8. (TO) ADD	- SLOJIT
9. (TO) LIGHT	- ZAJGI
10. (TO) CLOSE	- ZAKROY
11. (TO) WRITE	- PISAT
12. (TO) BRUSH	- POCHISTI
13. (TO) PLAY	- IGRAI
14. (TO) WIPE	- VEETRI
15. (TO) READ	- CHITAT
16. (TO) RUN	- BEJAT
17. (TO) SMILE	- OOLEBNIS
18. (TO) FLICKER	- MERKAET
19. (TO) CUT	- RESAT
20. (TO) REVOLVE	- VRATCHAYET

APPENDIX 2

Tables

TABLE 19

ANALYSIS OF COVARIANCE OF CRITERION MEASURE (Y)
AND MATCHING VARIABLE (X)

	Σy^2	d.o.f.	MS	F	Σx^2	MS	F	Σy^2_{adj}	d.o.f.	MS	F
Between Versions	60.48	4	15.12	-	128.70	32.17	1.52	93.89	4	23.47	2.51*
Between Lists (nouns, verbs)	32.07	1	32.07	1.38	15.29	15.29	-	6.21	1	6.21	-
Between Sex	366.72	1	366.72	15.78**	466.95	466.95	22.03**	2.44	1	2.44	-
Versions x List	39.88	4	9.97	-	170.65	42.66	2.01	51.59	4	12.90	1.38
Versions x Sex	32.51	4	8.13	-	103.99	26.00	1.23	48.63	4	12.16	1.30
Lists x Sex	9.12	1	9.12	-	11.23	11.23	-	32.79	1	32.79	3.50
Versions x Lists x Sex	33.08	4	8.27	-	45.11	11.28	-	32.02	4	8.01	-
Error	4147.48	200	23.24	-	4241.02	21.20	-	1864.30	199	9.37	-
Total	5221.35	219			5182.94				218		

$r_{xy} = .75$

** Significant at the .01 level of confidence

* Significant at the .05 level of confidence

TABLE 20

MEANS BY SEX AND GROUP ON PRE-TEST
FOR TEN EXPERIMENTAL GROUPS

Group	Males N = 26	Females N = 20	Total N = 46
Group 1	11.19	12.65	11.83
Group 2	11.19	12.62	11.82
Group 3	11.17	12.58	11.78
Group 4	11.17	12.50	11.75
Group 5	11.19	12.58	11.79
Group 6	11.19	12.52	11.77
Group 7	11.19	12.55	11.78
Group 8	11.23	12.58	11.82
Group 9	11.15	12.50	11.74
Group 10	11.17	12.42	11.72

TABLE 21

PRE-TEST MEAN RE-EQUATION SCORES FOR EXPERIMENT I

Group	Males N = 21	Females N = 18	Total N = 39
Group 5	11.60	13.11	12.29
Group 2	11.69	13.19	12.38
Group 1	11.69	13.22	12.40
Group 9	11.64	13.08	12.31

TABLE 22

ANALYSIS OF VARIANCE OF RE-EQUATED
PRE-TEST SCORE, EXPERIMENT I

Source	SS	d.o.f.	MS	F
1. Between Orders	0.0000	1	0.0000	
2. Between Sound	0.0064	1	0.0064	
3. Between Sex	87.0001	1	87.0001	3/11' F = 984.1640**
4. Order x Sound	0.3141	1	0.3141	4/10 F = 3.5016
5. Order x Sex	0.0258	1	0.0258	
6. Sex x Sound	0.0055	1	0.0055	
7. Sex x Order x Sound	0.0465	1	0.0465	
8. Between like Ranks (within sex)	1454.9326	37	39.3225	8/11 F = 444.8246**
9. Error	10.0078	111	0.0902	
10. Error + (Sex x Order x Sound)	10.0543	112	0.0897	
11. Error + (S x O x S) + (S x S) + (O x Sex)	10.0856	114	0.0884	
Total	1552.3076	155		

** Significant at .01 level or greater

' The sources of variance have been numbered. The number in the numerator is the number of the source whose variance is the numerator for F. The number in the denominator is the number of the source whose variance is the denominator for F.

TABLE 23

ANALYSIS OF VARIANCE OF LEARNING SCORES FOR ALL TRIALS, EXPERIMENT I

Source	SS	d.o.f.	MS	F	F
1. Between Orders	123.8525	1	123.8525	1/19' F = 15.51**	1/20 F = 8.31**
2. Between Sounds	1.8525	1	1.8525		
3. Between Sex	251.6263	1	251.6263	3/19 F = 31.51**	3/20 F = 16.87**
4. Between Trials	11652.9935	3	3884.3311	4/19 F = 486.35**	
5. Order x Sound	40.0065	1	40.0065	5/18 F = 5.00*	
6. Order x Sex	2.5006	1	2.5006	7/18 F = 5.08**	
7. Order x Trials	121.9168	3	40.6389		
8. Sound x Sex	.4451	1	0.4451		
9. Sound x Trials	26.8911	3	8.9637		
10. Sex x Trial	74.4748	3	24.8249	10/18 F = 3.10*	
11. Order x Sound x Sex	58.2912	1	58.2912	11/17 F = 7.20**	
12. Order x Sound x Trials	12.0704	3	4.0234		
13. Order x Sex x Trials	19.4007	3	6.4669		
14. Sound x Sex x Trials	0.7914	3	0.2638		
15. Order x Sound x Sex x Trials	16.0168	3	5.3389		
16. Between Ranks (Rank x Sex)	4056.3096	37	109.6299	16/17 F = 13.55**	
17. Error (Within Trials)	4490.2459	555	8.0905		
18. 17 + 15 + 14 + 13 + 12	4538.5258	567	8.0045		
19. 18 + 9 + 8 + 6	4568.3626	572	7.9867		
20. 15 + 14 + 13 + 12 + 11 ... + 5	372.8054	25	14.9122		
Total	20949.6858	623			

** Significant at .01 level or greater
* Significant at or between .05 – .01 levels
' See footnote Table 22

TABLE 24

ANALYSIS OF VARIANCE OF LAST LEARNING TRIAL, EXPERIMENT I

Source	SS	d.o.f.	MS	F	F
1. Between Orders	131.0834	1	131.0834	1/9' F = 13.54**	1/10 F = 13.58**
2. Between Sound	6.1603	1	6.1603		
3. Between Sex	139.7816	1	139.7816	3/9 F = 14.44**	
4. Order x Sound	20.8269	1	20.8269	4/9 F = 2.15	
5. Order x Sex	5.8035	1	5.8035		
6. Sound x Sex	.0124	1	.0124		
7. Order x Sound x Sex	9.0123	1	9.0123		
8. Between Ranks	1835.9108	37	49.6192	8/9 F = 5.13**	
9. Error	1074.3511	111	9.6788		
10. Combined Error (9 + 7 + 6 + 5 + 4)	1110.0062	115	9.6522		
Total	3222.9423	155			

** Significant at or beyond .01 level
* Significant at or between .05 - .01 levels
' See footnote Table 22

TABLE 25

ANALYSIS OF VARIANCE OF DIFFERENCE SCORES:
FORGETTING, EXPERIMENT I

Source	SS	d.o.f.	MS	F
1. Between Orders	55.1724	1	55.1724	1/9' F = 4.33*
2. Between Sound	4.9655	1	4.9655	
3. Between Sex	173.7992	1	173.7992	3/9 F = 13.65**
4. Between Ranks	803.7353	27	29.7679	4/9 F = 2.34**
5. Sound x Order	4.1724	1	4.1734	
6. Sound x Sex	2.3139	1	2.3139	
7. Order x Sex	18.6314	1	18.6314	
8. Sound x Order x Sex	1.7933	1	1.7933	
9. Within Groups	1055.4509	81	13.0302	
Error + Interactions	1082.3619	85	12.7336	
Total	2120.0344	115		

** Significant at or beyond .01 level
* Significant at or between .05 - .01 level
' See footnote Table 22

TABLE 26

ANALYSIS OF VARIANCE OF DIFFERENCE RELEARNING SCORES, EXPERIMENT I

	Source	SS	d.o.f.	MS	F
1.	Between Order	9.9656	1	9.9656	
2.	Between Sound	0.0000	1	0.0000	
3.	Between Sex	265.1214	1	265.1718	3/13' F = 25.70**
4.	Between Ranks (R x Sex)	553.1214	27	20.4859	4/13 F = 1.99
5.	Sound x Order	39.8620	1	39.8620	5/13 F = 3.86
6.	Sound x Sex	4.3002	1	4.0020	
7.	Order x Sex	4.2464	1	4.2464	
8.	Sound x Order x Sex	1.8108	1	1.8108	
9.	Within Group - Ranks	844.3148	81	10.4236	
10.	Rank x Sound x Sex	203.1998	27	7.5259	
11.	Rank x Order x Sex	32.2880	27	1.1958	
12.	Rank x Sound x Order x Sex	608.8270	27	22.5491	
13.	Combined Error (10+11+12)	846.1256	82	10.3186	
	Total	1722.7931	115		

** Significant at or beyond .01 level

' See footnote Table 22

TABLE 27

MEAN RE-EQUATION SCORES FOR EXPERIMENT II

Group	Males N = 21	Females N = 18	Total N = 39
Group 2	11.69	13.19	12.38
Group 3	11.69	12.92	12.26
Group 6	11.60	12.92	12.20
Group 9	11.64	13.08	12.31
Group 8	11.43	13.14	12.22
Group 4	11.64	13.00	12.27

TABLE 28

ANALYSIS OF VARIANCE OF RE-EQUATED PRE-TEST SCORES, EXPERIMENT II

Source	SS	d.o.f.	MS	F
1. Between Pictures	0.6175	2	0.3087	
2. Between Sounds	0.0171	1	0.0171	
3. Between Sex	118.3519	1	118.3519	
4. Picture x Sound	0.2073	2	0.1037	
5. Picture x Sex	0.2218	2	0.1109	
6. Sex x Sound	0.3364	1	0.3364	
7. Picture x Sex x Sound	1.5905	2	0.7952	7/9' F = 9.8415**
8. Between Ranks (Within Sex)	2207.4772	37	59.6615	
9. Error	14.9414	185	0.0808	
Total	2345.9957	233		

** Significant at or beyond .01 level

' See footnote Table 22

TABLE 29

ANALYSIS OF VARIANCE OF LEARNING SCORE FOR ALL TRIALS, EXPERIMENT II

Source	SS	d.o.f.	MS	F	F
1. Between Pictures	91.0833	2	45.5411	1/18' F = 5.79*	1/21 F = 9.07**
2. Between Sound	106.0096	1	106.0096	2/18 F = 13.49**	2/21 F = 21.12**
3. Between Sex	377.0477	1	377.0477	3/18 F = 47.96**	3/21 F = 75.11**
4. Between Trials	21291.0887	3	7097.0295	4/18 F = 902.83**	4/21 F = 1413.69**
5. Picture x Sound	0.3911	2	0.1955		
6. Picture x Sex	21.1296	2	10.5648		
7. Picture x Trials	19.3184	6	3.2197		
8. Sound x Sex	1.4897	1	1.4897		
9. Sound x Trials	10.6955	3	3.5651		
10. Sex x Trials	51.6553	3	17.2184	10/19 F = 2.18	10/20 F = 4.12*
11. Picture x Sound x Sex	41.5839	2	20.7919		
12. Picture x Sound x Trials	29.3269	6	4.8878		
13. Picture x Sex x Trials	10.0428	6	1.6738		
14. Sound x Sex x Trials	6.6729	3	2.2243		
15. Picture x Sex x Sound x Trials	8.5050	6	1.4175		
16. Between Ranks (Rank x Sex)	4456.5741	37	120.4479	16/17 F = 15.07**	
17. Error (Within Trials)	6803.2974	851	7.9944		
18. 17 + 15 + 14 + 13 + 12 + 11	6899.4289	874	7.8940		
19. 18 + 10 + 9 + 8 + 7 + 6 + 5	7004.1085	891	7.8609		
20. 15 + 14 + 13 + 12 + 11	96.1315	23	4.1796		
21. 20 + 10 + 9 + 8 + 7 + 6 + 5	200.8111	40	5.0202		
Total	33325.9134	935			

** Significant at or beyond .01 level
* Significant at or between .05 - .01 level
' See footnote Table 22

TABLE 30

ANALYSIS OF VARIANCE OF LAST LEARNING TRIAL,
EXPERIMENT II

Source	SS	d.o.f.	MS	F	F
1. Between Sound	36.9615	1	36.9615	1/9' F = 3.32-*	1/10 F = 3.40-*
2. Between Pictures	13.6410	2	6.8205		
3. Between Sex	109.8413	1	109.8413		
4. Sound x Picture	12.0001	2	6.0000		
5. Sound x Sex	1.6932	1	1.6932		
6. Picture x Sex	1.0997	2	.5488		
7. Sound x Picture x Sex	12.6984	2	6.3492		
8. Between Ranks	1603.3638	37	43.3341	8/9 F = 3.89**	
9. Error	2058.7393	185	11.1283		
10. Combined Error (9+7+6+5+4)	2086.2307	192	10.8657		
Total	3850.0384	233			

-* Short of .05 level
** Significant beyond .01 level
' See footnote Table 22

TABLE 31

ANALYSIS OF VARIANCE OF DIFFERENCE SCORES:
FORGETTING, EXPERIMENT II

Source	SS	d.o.f.	MS	F
1. Between Pictures	32.5200	2	16.2600	1/10' F = 1.18
2. Between Sound	110.9400	1	110.9400	2/10 F = 8.06**
3. Between Sex	41.1933	1	41.1933	3/10 F = 2.99
4. Between Rank and Sex	585.5000	23	25.4565	4/10 F = 1.85*
5. Sound x Picture	64.3600	2	32.1800	5/10 F = 2.50
6. Sound x Sex	42.7201	1	42.7201	6/10 F = 3.32
7. Picture x Sex	91.4290	2	45.7145	7/10 F = 3.56*
8. Sound x Picture x Sex	2.0287	2	1.0144	
9. Error	1478.1687	115	12.8536	
10. Error x Interaction	1678.7065	122	13.7598	
Total	2448.8606	149		

** Significant at or beyond .01 level
* Significant at or between .05 - .01 level
' See footnote Table 22

TABLE 32

ANALYSIS OF VARIANCE OF DIFFERENCE RELEARNING SCORES, EXPERIMENT II

Source	SS	d.o.f.	MS	F
1. Between Pictures	10.8934	2	5.4467	
2. Between Sound	52.8067	1	52.8067	2/9' F = 4.69*
3. Between Sex	34.5215	1	34.5215	3/9 F = 3.07
4. Rank x Sex	515.1842	23	22.3993	4/9 F = 1.99*
5. Sound x Picture	4.4133	2	2.2067	
6. Sound x Sex	9.9326	1	9.9326	
7. Picture x Sex	79.9617	2	39.9808	7/9 F = 3.55*
8. Sound x Picture x Sex	23.4545	2	11.7272	
9. Within Groups	1294.7053	115	11.2583	
Total	2025.8732	149		

* Significant at or between .05 - .01 level

' See footnote Table 22

TABLE 33

MEAN RE-EQUATION SCORE FOR EXPERIMENT III

Group	Males N = 21	Females N = 18	Total N = 39
Group 3	11.50	13.47	12.40
Group 7	10.74	13.66	12.07
Group 6	11.05	13.59	12.21
Group 10	11.09	12.97	11.96

TABLE 34

ANALYSIS OF VARIANCE OF RE-EQUATED PRE-TEST SCORES, EXPERIMENT III

Source	SS	d.o.f.	MS
1. Between Pictures	1.1683	1	1.1683
2. Between Word Pictures	0.5785	1	0.5785
3. Between Sex	88.2723	1	88.2723
4. Picture x Sex	1.1685	1	1.1685
5. Titles x Sex	0.8932	1	0.8932
6. Picture x Titles	1.5400	1	1.5400
7. Picture x Titles x Sex	.0707	1	.0707
8. Between Ranks	1501.7694	37	40.5883
9. Error	10.0182	111	.0903
Total	1605.4791	155	

TABLE 35

ANALYSIS OF VARIANCE OF LEARNING SCORE FOR ALL TRIALS, EXPERIMENT III

Source	SS	d.o.f.	MS	F	F
1. Between Word Presence	42.5786	1	42.5785	1/28' F = 6.03***	
2. Between Still - Motion	2.4375	1	2.4375		
3. Between Sex	293.8272	1	293.8272	3/28 F = 41.61**	
4. Between Trials	15235.9407	3	5078.6469	4/28 F = 719.15**	
5. Word Presence x Motion	2.6939	1	2.6939		
6. Word Presence x Sex	30.0201	1	30.0201	6/27 F = 4.22*	
7. Word Presence x Trials	14.6330	3	4.8776		
8. Motion x Sex	0.5223	1	0.5223		
9. Motion x Trials	11.3125	3	3.7708		
10. Sex x Trials	86.8594	3	28.9531	10/28 F = 4.07**	
11. Word x Motion x Sex	17.3850	1	17.3850	11/22 F = 5.85*	11/26 F = 2.42
12. Word x Motion x Trials	1.7484	3	0.5828		
13. Word x Sex x Trials	26.5482	3	8.8494	13/21 F = 3.00*	13/26 F = 1.23
14. Motion x Sex x Trials	1.6423	3	0.5474		
15. Word x Motion x Sex x Trials	9.4843	3	3.1614	15/23 F = 2.37	
16. Between Ranks (Rank x Sex)	2898.1087	37	78.3272		
17. Rank x Word x Sex	588.8590	37	15.9151	17/22 F = 5.35**	
18. Rank x Motion x Sex	889.0000	37	24.0270	18/22 F = 8.08**	
19. Rank x Trials x Sex	837.3718	111	7.5438	19/22 F = 2.54**	
20. Rank x Word x Motion x Sex	860.7436	37	23.2633	20/23 F = 17.44	
21. Rank x Word x Trial x Sex	327.6795	111	2.9520	21/23 F = 2.21**	
22. Rank x Motion x Trials x Sex	330.0000	111	2.9729	22/23 F = 2.23**	
23. Rank x Motion x Word x Trial x Sex	148.1023	111	1.3342		
24. 23+15+14+12	160.9773	120	1.3414		
25. 23+15+14+13+12+11	240.9102	124	1.6525		
26. 17+18+19+20+21+22+23	3981.7562	555	7.1743		
27. 27+15+14+13+12+11	4038.5644	568	7.1101		
28. 28+9+8+7+5	4067.7261	576	7.0620		
Total	22657.4983	623			

*** Significant at .02 level
** Significant at .01 level or beyond
* Significant at .05 level
' See footnote Table 22

TABLE 36

ANALYSIS OF VARIANCE OF LAST ACQUISITION TRIAL,
EXPERIMENT III

Source	SS	d.o.f.	MS	F
1. Between Word Presence	3.6922	1	3.6922	
2. Between Pictures	2.5640	1	2.5640	
3. Between Sex	92.1442	1	92.1442	3/10' F = 11.7658**
4. Word Presence x Picture	2.5643	1	2.5643	
5. Pictures x Sex	.0014	1	.0014	
6. Word Presence x Sex	20.3334	1	20.3334	
7. Word Presence x Pictures x Sex	.0808	1	.0808	
8. Between Rows	1188.4109	37	32.1192	8/10 F = 4.10**
9. Error	877.6447	111	7.9067	
10. Combined Error	900.6246		7.8315	
Total	3187.4358	155		

** Significant beyond .01 level
' See footnote Table 22

TABLE 37

ANALYSIS OF VARIANCE OF DIFFERENCE SCORES: FORGETTING, EXPERIMENT III

Source	SS	d.o.f.	MS	F
1. Between Titles	14.2857	1	14.2857	1/10' F = 1.66
2. Between Pictures	10.3214	1	10.3214	2/10 F = 1.20
3. Between Sex	81.5186	1	81.5186	3/10 F = 9.48**
4. Rank x Sex	520.3386	26	20.0130	4/10 F = 2.33
5. Pictures x Titles	6.0358	1	6.0358	
6. Pictures x Sex	31.8817	1	31.8817	6/10 F = 3.95*
7. Titles x Sex	28.8757	1	28.8757	7/9 F = 3.58
8. Pictures x Titles x Sex	9.1674	1	9.1674	8/9 F = 1.14
9. Error	629.4322	78	8.0696	
10. Error + Interactions	705.3928	82	8.6023	
Total	1331.8579	111		

** Significant beyond .01 level
* Significant at .05 level
' See footnote Table 22

TABLE 38

ANALYSIS OF VARIANCE OF DIFFERENCE RELEARNING SCORES, EXPERIMENT III

Source	SS	d.o.f.	MS	F
1. Between Titles	45.0089	1	45.0089	1/9' F = 5.12*
2. Between Pictures	0.2232	1	0.2232	
3. Between Sex	82.5067	1	82.5067	3/9 F = 9.39**
4. Rank x Sex	658.2344	26	25.3167	
5. Pictures x Titles	29.0090	1	29.0090	5/9 F = 3.30
6. Pictures x Sex	2.4174	1	2.4174	
7. Titles x Sex	15.2150	1	15.2150	
8. Pictures x Titles x Sex	4.8817	1	4.8817	
9. Within Groups	685.4947	78	8.7883	
Total	1522.9910	111		

** Significant beyond .01 level
* Significant between .05 - .01 level
' See footnote Table 22